



Risk assessment and communication on the use of ruthenium-106 brachytherapy in a multi-disciplinary medical environment

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Risk management in radiation protection

- Strategy based on balance of risks and benefits
- ICRP internationally recommended system of radiological protection
- Three basic principles
 - Justification net benefit to society
 - Optimization ALARA
 - Dose limitations







Risk assessment for the introduction of Ru-106 eye plaques in brachytherapy for eye tumours

Unique Plaque Design

The core of the Ru-106 Eye Applicator consists of a foil coated with Ru-106/Rh-106. This core is safely encapsulated within pure silver sheets. The silver backing acts as a radiation shield and absorbs approximately 95 % of the beta radiation.







Step 1: identify the risk

Ru-106 / Rh-106 => Pd-106:

Ru-106 is a pure beta-emitter (ßmax: 3,5 MeV) with a half-life of 371.5 days that decays to Rh-106, its daughter with half-life of only 30 s, so there is secular equilibrium after only a few minutes. Rh-106 is also a pure beta-emitter but its decay is followed by emission of gamma-rays from deexcitations of its daughter-nucleus Pd-106. These gamma-rays can be used for detection.

- Sealed source, reusable up to 18 months: Needs steam sterilisation after application (max. 50 cycles)
- Produced with nominal reference dose rate of 80 mGy/min.
 (tolerance from -10% to +60%).
- Application time: 3 7 days

Risk: external exposure





High dose at the base of the tumour while sparing the organs at risk.

Step 2: Who might be harmed and how

Equivalent dose rate around the patient ?
 Assumptions: Source activity: 20 MBq , shielding: 1.5 cm tissue
 Estimated equivalent dose rate due to γ-radiation: At 10 cm: 55 µSv h-1
 At 30 cm: 15 µSv h-1

At 1 motors 1 uCych 1

At 1 meter: 1 µSv h-1

	Handeling	Locatie	Medewerker(s)	Type zone
Т	Indienststelling en geregelde	168.01.07.07	Medewerker	Bewaakt
	fysische controle applicator	(berging 3)	radioprotectie	
2	Applicator klinisch vrijgeven	168.01.07.07	Medisch fysicus	Bewaakt
		(berging 3)		
3	Applicator gereedmaken	168.01.07.07	Medewerker	Bewaakt
	voor sterilisatie	(berging 3)	<u>Qka</u> oogziekten	
4	Applicator steriliseren	Sterilisatie	Medewerker	
	in de volledig afgeschermde	OKA	Sterilisatie	
	Sterilisatiecontainer	oogziekten –		
		168.01.07.03		
5	Applicator aanbrengen op	E770 - OKA	Oogchirurg	
	het oog van de patiënt	oogziekten		
6	Verpleging van patiënt met	E 722	Verplegend	
	de applicator		personeel	
7	Applicator verwijderen-	E770 - OKA	Oogchirurg	
	ontladen van de patiënt	oogziekten		
8	Applicator schoonmaken en	168.01.07.07	Medewerker	Bewaakte
	opslag in loodkluis	(berging 3)	<u>Qka</u> oogziekten	

 $\boldsymbol{\beta}$ radiation is completely absorbed by the patient

Step 3: Evaluate the risks + Decide on precautions

Radioactive encapsulated source:

- Provide shielding for source and workstation
- Lockable storage
- Symbol of ionizing radiation: designated area
- The necessary protective equipment is present: tweezers to manipulate source, source and sterilization container,
- Emergency procedure present + contact details of who to contact
- Regular leak/wipe tests to verify the integrity of the source ...

New medical application:

mandatory commissioning = approval of type of source and testing of safety devices Quality Control (QC) =

- calibration test of the source: medical physics
- intactness encapsulated source: health physics



Voor – en zijaanzicht van de werkpost in lokaal168.01.07.07 .



Step 4: Record the outcome + implement

Doserate during manipulation of the source

Voor de verschillende Ru-106 <u>oogapplicatoren</u> worden de volgende maximale dosistempi gemeten (in µSv/h) op het moment van indienststelling op 11 januari en op 1 februari 2018.

	Holle zijde		Bolle zijde	
Buthanium as maalisatan	Hp(10)	Hp(0.07)	Hp(10)	Hp(0.07)
Ruthenium oogappiicator	γ-straling	p-straling	γ-straling	p-straling
CCA (#2297) @ contact	22000	50000	460	2000
CCA @ 5 cm	3500	10000	250	950
CCA @ 12 cm	2400	6200	80	210
CCA @ 30 cm	780	1600	25	60
CCA @ zijopening loodkasteel	100	150	5	20
CCA @ voor operatorscherm	< 1	6	< 1	6

Dose rate during cleaning of the source

Bron ondergedompeld in potje waterige oplossing min. 5 cm hoog gevuld (bron met de bolle kant naar boven)

CCA @ 3 cm (bij contact aan zijkant)	52	
CCA @ 5 cm (waar potje wordt vastgehouden)	40	
CCA @ 7 cm (vlak boven potje)	32	
CCA @ 30 cm (boven potje)	6	
CCA @ 100 cm (boven potje)	1	

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Step 4: Record the outcome + implement

SOP: integrate in the total medical workflow



Thank you

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